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INSTRUCTION MANUAL

VSWR AMPLIFIER

NARDA MODEL 441B

RETURN TO
AEROSPACE DIV.

narda

the narda microwave corporation
MINEOLA, NEW YORK.

INSTRUCTION MANUAL

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April 17, 1961

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APPENDIX

The Narda Model 441B VSWR Amplifier is powered by a self-contained rechargeable nickel cadmium battery. The battery is recharged from the 115 volt 60 cycle AC line by means of a built-in charger circuit which is controlled by a switch on the front panel. Normal operating voltage of the battery is 12 volts. It has a 500 ma hour rating. Beginning with a fully charged battery, the unit will operate before recharge is required, for at least 30 hours depending primarily upon the use of the bolometer bias circuit. The battery drain is 6 ma with the unit operating in the CRYSTAL position and 17.5 ma in the BOLOMETER HIGH position.

In recharging the battery, an internal charger will deliver 30 ma to the battery and will recharge a fully discharged battery in approximately 35 hours. If the unit is operating at the same time that the battery is being charged, the recharge time will be longer inasmuch as the charger is essentially a constant current device, and its total delivered current will divide between the battery and the load. Damage to the battery is unlikely to occur regardless of charge and discharge cycle used.

INSTRUCTION MANUAL

NARDA MODEL 441B

APPENDIX II

On Narda Model 441B VSWR Amplifier, starting at Serial Number 27, the function of the charger switch has been changed as follows:

When the line cord is plugged into a 115V power line, the battery is on continuous charge and the panel lamp will be illuminated. To check the battery voltage, press the Battery Check Switch to the left; the battery voltage will be indicated on the main panel meter. The red line on the top scale of the meter marked BATTERY MINIMUM corresponds to a battery voltage of 11.5 volts. For proper operation of the VSWR Amplifier, this CHECK should cause a meter indication equal to, or higher than, the BATTERY MINIMUM line. With the lever switch in the momentary CHECK position, the charger is switched off as indicated by extinguishing of the CHARGING indicator. Portable operation of the VSWR Meter is possible by simply disconnecting the line cord from the power line. During portable operation, battery voltage checks may be made periodically by means of the momentary switch to determine when the battery needs recharging.

APPENDIX II

On Serie Model 4610 VHF Amplifier, starting at Serial Number 57, the function of the charger switch has been changed as follows:

When the line cord is plugged into a 115V power line, the battery is on continuous charge and the panel lamp will be illuminated. To check the battery voltage, press the Battery Check Switch to the left; the battery voltage will be indicated on the main panel meter. The red line on the top scale of the meter marked BATTERY MINIMUM corresponds to a battery voltage of 13.5 volts. For proper operation of the VHF Amplifier, this CHECK should cause a meter indication equal to, or higher than, the BATTERY MINIMUM line. With the power switch in the momentary CHECK position, the charger is switched off an indicated by extinguishing of the CHARGING indicator. Portable operation of the VHF Meter is possible by simply disconnecting the line cord from the power line. During portable operation, battery voltage checks may be made periodically by means of the momentary switch to determine when the battery needs recharging.

CONNECTIONS FOR 115 AND 230 VOLTS OPERATION

Provision has been made for either 115 or 230 volts operation of the internal battery charger. (See Figure 1.) As shipped from the factory, the jumpers on the charger transformer T2 located on the underside of the chassis are placed between Terminals 1 and 3, and 2 and 4 to permit operation from a nominal 115 volts power line (Figure 1b). The dual primary transformer windings are in parallel and properly phased for this operation. For operation from a nominal 230 volt power source, remove both jumpers; disconnect the wire from Terminal 2, and connect it to Terminal 4; and insert jumper diagonally between Terminals 2 and 3 (Figure 1c). This will place the transformer primary windings in series and properly phased for nominal 230 volts operation.

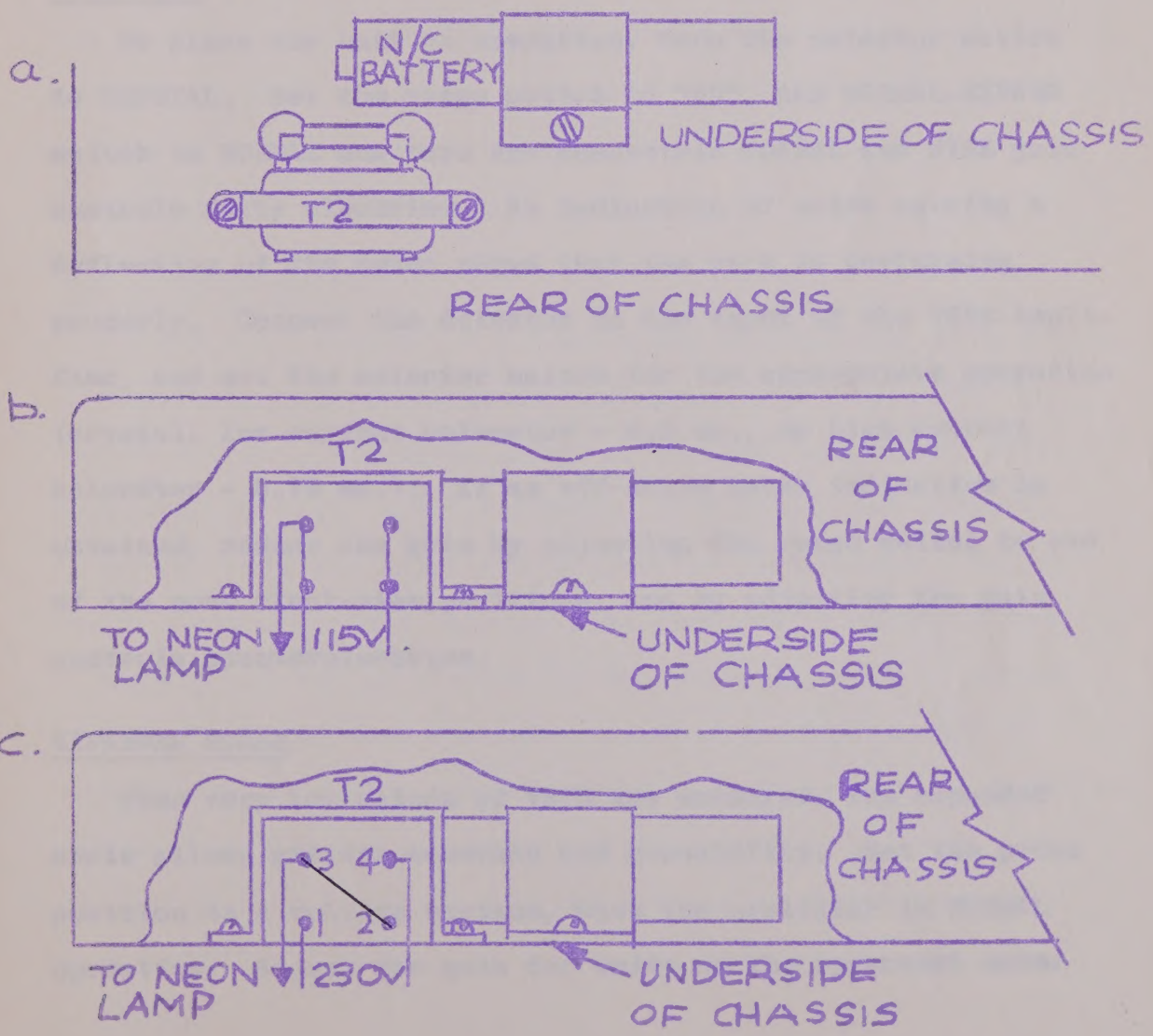
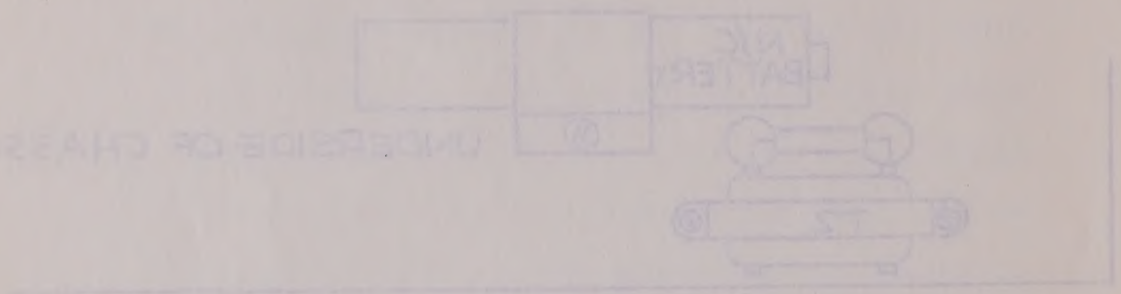


FIGURE 1



REAR
OF
CHASSIS
T2
TO NEON LAMP

REAR
OF
CHASSIS
T2
TO NEON LAMP

Narda Model 161 VSWR Amplifier is a calibrated high gain amplifier to be used for measurements of VSWR, impedance, and relative power levels. The meter, which deflects in proportion to the input signal level, is calibrated directly in VSWR and decibels. When a square law detector supplies the input signal, values of VSWR up to 1000 can be measured.

OPERATION

To place the unit in operation, turn the selector switch to CRYSTAL. Set the range switch to "SD", the NORMAL-EXPAND switch to NORMAL and turn the concentric COARSE and FINE gain controls fully clockwise. An indication of noise causing a deflection of the meter shows that the unit is performing properly. Connect the detector to the input of the VSWR Amplifier, and set the selector switch for the appropriate operation (crystal, low current bolometer - 4.5 ma., or high current bolometer - 9.75 mA.). If an off-scale meter indication is obtained, reduce the gain by adjusting the range switch to one of the more clock-wise positions, and by adjusting the gain controls counterclockwise.

EXPANDED SCALE

When very low values of VSWR are measured, the expanded scale allows greater accuracy and readability. Set the probe position to a voltage maximum, with the amplifier in NORMAL operation. Adjust the gain for unity on the uppermost meter

scale, and switch to EXPAND. The meter will read approximately unity on the EXPANDED VSWR scale. Adjust the FINE GAIN for unity on the EXPANDED VSWR scale, and proceed with the VSWR measurement in the usual manner.

EXTERNAL CONNECTIONS

In the rear of the unit are provided two jacks for the measurement of bolometer current and output. A low resistance (20 ohms est.) d.c. milliammeter should be used for measurement of bolometer current. The output jack should be used with a recorder or other monitoring device of high input impedance - at least 0.5 megohms.

THEORY OF OPERATION

Model 441 consists of a four-stage preamplifier with decade attenuators, gain controls and frequency selective network, together with a two-stage metering feedback amplifier, meter expanding circuit, and a bolometer bias supply for external elements. All amplifier stages utilize transistors. The two stage meter amplifier incorporates feedback to insure linearity. A bucking current is applied to the meter in order to expand the meter scales when desired. Zener Diode CR-5 serves to regulate this current against aging battery supplies. Potentiometer R-18 permits adjustment of this bucking current. Resistors R17, R44 and R45 provide a means of maintaining the same apparent gain in both the normal and expand operation.

Bolometer bias is provided by battery B1 and the network containing R1, R2, R3, C1, CR1, and CR2. Zener Diode CR-2 serves to regulate the bias current and to prevent too high a charge from building up on C1 when no bolometer element is connected. Protection against bolometer burnout upon "connect" is thereby obtained. CR-1 is reversed biased when current is supplied to the external element, but it protects against high induced voltages across the transformer primary winding upon "disconnect". Complete protection against bolometer burnout is thereby provided.

CONSTRUCTION

Printed circuit and dip soldering techniques have been employed in the construction of the Narda VSWR Amplifier. The majority of the components have been mounted on a phenolic board which is supported on the upper side of the chassis. Frequency selective networks are supplied in sealed closures, and plug into an octal socket on the chassis.

Accessible from the bottom of the unit is a stand which may be withdrawn from within the case and swung either forward or backward. The instrument may thus be tilted backward or forward for greater ease of reading, and to aid in eliminating parallactic errors in meter reading.

MAINTENANCE

The expand adjust potentiometer R48 is located on the rear of the chassis. This potentiometer controls the bucking current applied to the meter for expanded scale operation. It is adjusted at the factory and should seldom require resetting. Should an adjustment appear necessary, it can be accomplished by placing the instrument in operation in the EXPAND condition, and applying a signal sufficient to drive the meter upscale to "0" db point should be rechecked after each adjustment of R48 because adjustment of the potentiometer will cause both the "0" db and the "2" db points to shift. Several successive adjustments of the potentiometer must be made in order to accurately make this calibration.

Should it become necessary to remove the unit from the cabinet for servicing, this can be done by first removing the feet and then pushing the chassis and front panel assembly out the front of the housing. The stand must be pushed up inside the unit before doing this because it is part of the chassis.

ACCESSORIES

Additional plug-in tuned circuits with any center frequency from 315 to 3000 cps may be obtained.

A plug-in circuit for broad-band operation reduces the sensitivity to 3.0 microvolts for full scale. Bandwidth is then 240 to 4000 cps.

ADDITIONAL EQUIPMENT

Narda Waveguide Slotted Line Impedance Meters are available for impedance and VSWR measurements in all waveguide sizes. Narda Coaxial Slotted Line Impedance Meters are available for measurements from 425 to 12,400 mc. with a variety of connector types.

A complete line of Narda Waveguide and Coaxial Bolometer Mounts may be used for attenuation measurements with the VSWR Amplifier.

Narda Bolometers recommended for use with the VSWR Amplifier:

(Any 200 ohm bolometer requiring 6.5 or 8.75 ma bias may be used, however.)

For VSWR - N610B, N321B

For Attenuation - N505, N510A, N411B, N403 (Coaxial)

TRANSISTORIZED, NARDA MODEL 441B

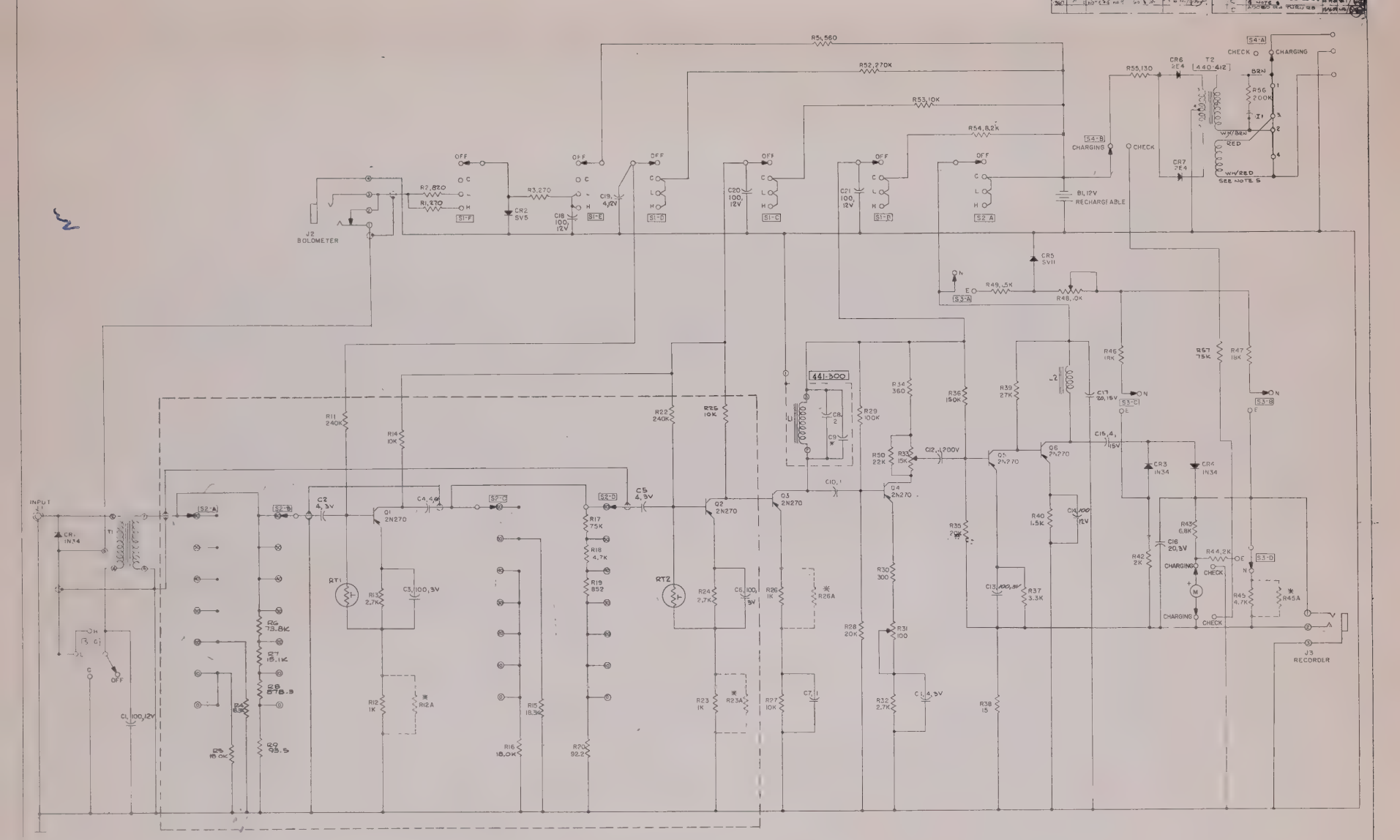
SPECIFICATIONS

Sensitivity:	0.1 microvolts at 200 ohms for full scale. (NOTE: Same sensitivity for "normal" and "expanded VSWR" scales.)
Noise:	less than 0.02 microvolts equivalent
Frequency:	1000cps plug/minus 1% (plug-in frequency networks available for 315-3000 cps)
Bandwidth:	25-30 cps
Range:	72db; minimum 60db in 10db steps, 11db min. continuous - coarse gain; approx. 0.8db fine gain
Accuracy:	Range Attenuator ± 0.1db on one range ± 0.2db maximum cumulative Meter Linearity 1% of full scale
Meter Scales:	VSWR 1-4 VSWR 3-10 db 0-10 expanded VSWR 1-1.3 expanded db 0-2
Input Impedance:	200 ohms
Inputs:	microwave crystal or bolometer (4.5 or 8.75 ma bias)
Bolometer Bias:	4.3 ma or 8.4 ma NOTE: Protective circuit permits any switching operation or cable connections to be made or broken without danger to the bolometer.
Power:	Rechargeable nickel cadmium battery, 127 500 ma hour rating.
Size:	8" wide, 7" high, 7-1/2" deep
Weight:	9 pounds

Controls and Connections

Attenuation:	0-60 db
Coarse Gain:	11 db min.
Fine Gain:	.8 db
Input:	Type BNC, 200 ohms
Output:	Jack for high impedance recorder (back panel)
Bolometer Bias:	Jack (back panel)
Scale Selector:	Normal - Expand

Price:	$225.00



NOTES

1 ALL RESISTOR'S IN OHMS
2 ALL CAPACITOR'S IN MICROFARAD'S AND 6 VOLTS UNLESS OTHERWISE SPECIFIED
3 * SELECT ON TEST
4 THIS DWG APPLICABLE FOR SERIAL Nos 267, 293, 275 & UP
5.(a) FOR 115V OPERATION, ADD JUMPERS AS ABOVE FROM 1 TO 3 & 2 TO 4
(b) FOR 230V OPERATION, REMOVE JUMPERS FROM 1 & 3 & 2 & 4 & CONNECT JUMPER PER DOTTED CONNECTION BETWEEN 2 & 3

SWR AMPLIFIER SCHEMATIC

TABLE OF REFERENCED PARTS

FOR

NARDA MODEL 441B

* Parts which can be replaced at factory only.
All other parts can be replaced by customer.

REFERENCE DESIGNATION	PART NO.	DESCRIPTION	MANUFACTURER
B1	10V0.500	Battery 12V 500MAH	Gulton Industries
C1, C18, C20, C21	30D154	Capacitor, 100uf, 12V	Sprague
C2, C5, C11	30D103	Capacitor, 4uf, 3V	Sprague
C3, C6	30D114	Capacitor, 100uf 3V	Sprague
C13	30D135	Capacitor, 100uf 6V	Sprague
C4	30D124	Capacitor, 4uf, 6V	Sprague
C14	30D154	Capacitor, 100uf 12V	Sprague
C7, C10	30D121	Capacitor, 1uf, 6V	Sprague
C12	109P10492	Capacitor, 0.1uf, 200V	Sprague
C19	30D143	Capacitor, 4uf, 12V	Sprague
C15	30D161	Capacitor, 4uf, 15V	Sprague
C16	30D109	Capacitor, 20uf, 3V	Sprague
C17	30D167	Capacitor, 20uf 15V	Sprague
CR1, CR3, CR4	IN34	Diode	----
CR2	IN705	Zener Reference Diode	Transitron
CR5	UNZ10T10	Zener Reference Diode	Transitron

TABLE OF REFERENCED PARTS

FOR

NARDA MODEL 441B

- continued -

REFERENCE DESIGNATION	PART NO.	DESCRIPTION	MANUFACTURER
CR6, CR7	2E4	Diods	Int'l. Rect. Corp.
I1	NE-51	Lamp, Neon	---
J1	UG-1094/U	BNC Receptacle	---
J2	13B	Jack	Switchcraft
J3	12B	Jack	Switchcraft
*	441-300	Tuned Circuit Assy.	Narda
L2	Dot 27	Choke	United Transformer
M1	441-101	Meter	Narda
Q1*, Q2*, Q3*, Q4*, Q5*, Q6*	2N270	Transistor, PNP	R. C. A.
R1, R3	EB-1/2	Resistor, 270Ω ±5%	Allen Bradley
R2	EB-1/2	Resistor, 820Ω ±5%	Allen Bradley
R4*, R15*	441B-R4-R15	Resistor, 18.3KΩ ±0.5%	Narda
R5*, R16*	441B-R5-R16	Resistor, 18.0KΩ ±0.5%	Narda
R6*	441B-R6	Resistor, 73.8KΩ ±0.5%	Narda
R7*	441B-R7	Resistor, 15.1KΩ ±0.5%	Narda
R8*	441B-R8	Resistor, 878.3Ω ±0.5%	Narda

TABLE OF REFERENCED PARTS

FOR

NARDA MODEL 441B

- continued -

REFERENCE DESIGNATION	PART NO.	DESCRIPTION	MANUFACTURER
R9*	441B-R9	Resistor, 93.5Ω ±0.5%	Narda
R11, R22	EB-1/2	Resistor, 240KΩ ±5%	Allen Bradley
R12, R23, R26	EB-1/2	Resistor, 1.0KΩ ±5%	Allen Bradley
R13, R24, R32	EB-1/2	Resistor, 2.7KΩ ±5%	Allen Bradley
R14, R25, R27, R53	EB-1/2	Resistor, 10KΩ ±5%	Allen Bradley
R17*	441B-R17	Resistor, 75KΩ ±0.5%	Narda
R18*	441B-R18	Resistor, 14.7KΩ ±0.5%	Narda
R19*	441B-R19	Resistor, 852Ω ±0.5%	Narda
R20*	441B-R20	Resistor, 92.2Ω ±0.5%	Narda
R28, R35	EB-1/2	Resistor, 20KΩ ±5%	Allen Bradley
R29	EB-1/2	Resistor, 100KΩ ±5%	Allen Bradley
R30	EB-1/2	Resistor, 300Ω ±5%	Allen Bradley
R31, R33	441-403	Dual Potentiometer	Narda

TABLE OF REFERENCED PARTS

FOR

NARDA MODEL 441B

- continued -

REFERENCE DESIGNATION	PART NO.	DESCRIPTION	MANUFACTURER
R34	EB-1/2	Resistor, 360Ω ±5%	Allen Bradley
R36	EB-1/2	Resistor, 150KΩ ±5%	Allen Bradley
R37	EB-1/2	Resistor, 3.3KΩ ±5%	Allen Bradley
R38	EB-1/2	Resistor, 15Ω ±5%	Allen Bradley
[illegible]	EB-1/2	Resistor, 27KΩ ±5%	Allen Bradley
R40, R41	EB-1/2	Resistor, 1.5KΩ ±5%	Allen Bradley
R42, R44	EB-1/2	Resistor, 2.0KΩ ±5%	Allen Bradley
R43	EB-1/2	Resistor, 6.8KΩ ±5%	Allen Bradley
R45	EB-1/2	Resistor, 4.7KΩ ±5%	Allen Bradley
R46, R47	EB-1/2	Resistor, 18KΩ ±5%	Allen Bradley
[illegible]	441-402	Potentiometer	Narda
R49	EB-1/2	Resistor, 22KΩ ±5%	Allen Bradley
R51	EB-1/2	Resistor, 560Ω ±5%	Allen Bradley
R52	EB-1/2	Resistor, 270KΩ ±5%	Allen Bradley
R53	EB-1/2	Resistor, 8.2KΩ ±5%	Allen Bradley

TABLE OF REFERENCED PARTS

FOR

NARDA MODEL 441B

- continued -

REFERENCE DESIGNATION	PART NO.	DESCRIPTION	MANUFACTURER
R55	EB-1/2	Resistor, 130Ω ±5%	Allen Bradley
R56	EB-1/2	Resistor, 200KΩ ±5%	Allen Bradley
R57	Type MDC	Resistor, 75KΩ ±1%	I. R. C.
RT1, RT2	45R8	Thermistor, 50KΩ	Veco
S1	441-400	Selector Switch	Narda
S2	441-401	Range Switch Assy.	Narda
S3	1459	Normal Expand Switch Assy.	Narda
S4	1457	Charge Switch Assy.	Narda
T1	0-9	Transformer	U. T. C.
T2	440-412	Transformer	Narda

PARTS OF REFERENCE DESIGN

VOA

MARCH MODEL 464B

- continued -

REFERENCE DESIGNATION	REF. NO.	DESCRIPTION	MANUFACTURER
R25	MB-1/2	Resistor, 130Ω ±5%	Allen Bradley
R26	MB-1/2	Resistor, 500Ω ±5%	Allen Bradley
R27	Type MDC	Resistor, 750Ω ±1%	I, R, C.
RV1, RV2	4588	Thermistor, 500Ω	Veco
S1	441-400	Selector Switch	Marda
S2	441-401	Range Switch Assy.	Marda
S3	1438	Normal Expand Switch Assy.	Marda
S4	1457	Charge Switch Assy.	Marda
T1	0-9	Transformer	U. T. C.
T2	440-412	Transformer	Marda